

NASKAH PUBLIKASI

**PENGARUH PENGGUNAAN EARPHONE
TERHADAP GANGGUAN PENDENGARAN**



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**PROGRAM STUDI PENDIDIKAN DOKTER
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HALAMAN PENGESAHAN NASKAH PUBLIKASI

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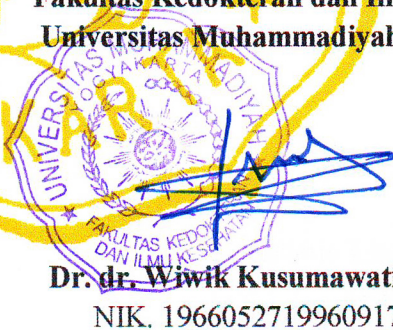
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The Correlation between Earphone Use toward Hearing Disorders

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Abstract

Purpose: to know the correlation between earphone use in listening activity toward hearing disorders. **Method:** observational research that is conducted by using cross sectional approach. Data analysis is done by using Gamma method. The respondents are 16-28 years old and often use earphone. These respondents are rated by questionnaire obtained from Department of Acoustics Aalborg University Beatriz Gutierrez Camarero Irene Moledero Domingues. **Result:** There are 45 respondents (36 of them are 16-22 years old and 9 of them are 23-28 years old) who often use earphone. The highest intensity of earphone use is ≤ 3 hours in a week (26 respondents/57.8%), the longest duration of earphone use is 1-5 years (21 respondents/46.7%), and the most used devices are MP3, cellphone, portable radio, PDA (44 respondents/97.8%). There is no significant relation ($P=0,05$) between the intensity of earphone use, the duration of earphone use, and the type of device toward the frequency of audiometry result. **Conclusion:** Statistically, there is no significant correlation between the intensity of earphone use, the duration of earphone use, and the type of devices toward hearing disorder.

Tujuan: Mengetahui hubungan mendengarkan suara melalui earphone terhadap gangguan pendengaran. **Metode:** penelitian observasional dengan pendekatan cross sectional dan analisis data menggunakan metode Gamma. Responden berusia 16-28 tahun dan sering menggunakan earphone dinilai menggunakan kuesioner yang diperoleh dari Department of Acoustics Aalborg University Beatriz Gutiérrez Camarero Irene Moledero Domínguez. **Hasil :** Sebanyak 45 responden (36 responden dengan usia 16-22 tahun dan 9 responden dengan usia 23-28 tahun) yang sering menggunakan earphone dengan intensitas pemakaian tertinggi selama ≤ 3 jam dalam seminggu 26 (57.8%), lama pemakaian earphone terbanyak selama 1-5 tahun 21 (46.7%), dan berdasarkan perangkat yang digunakan paling banyak pada kategori perangkat MP3, telepon seluler, radio portable, PDA 44 (97.8%). Tidak ada hubungan yang signifikan ($P = 0.05$) antara intensitas pemakaian earphone, lama pemakaian earphone, dan perangkat yang digunakan dengan frekuensi hasil audiometri. **Kesimpulan :** Tidak terdapat hubungan yang signifikan secara statistic antara intensitas pemakaian earphone, lama pemakaian earphone, dan perangkat yang digunakan terhadap gangguan pendengaran. Tetapi, terdapat peningkatan ambang paling banyak di frekuensi 500 Hz telinga kanan. Dan peningkatan ambang tertinggi pada frekuensi 8000 Hz telinga kiri mencapai 45 db.

Kata Kunci : Earphone, perubahan ambang, perangkat

PREFACE

Earphone is a tool that can convert electrical energy into sound wave.¹ Usually, this tool is used for listening sound and voices from communication device or computer. Along with current enhancement of audio-visual technology and telecommunication, the earphone use for listening music from cellular phone and other audio devices is increased.¹

Hearing disorder caused by noise (Noise Induced Hearing Loss) happens when ears are exposed to loud noise in a long period of time.¹

World Health Organization (WHO) reports that more than 5,3% of world population (360 million people) suffer from hearing disorder. With the rapid development of smartphone and MP3 player these days, the use of personal voice equipment (earphone) is also increased. NIHL among adolescent population occurs more often than before. A research on clinical data has been conducted in Germany and it estimates that one out of ten adolescents has NIHL level from leisure-time noise activities. If human's ears are exposed to noise in a long period of time and over 85dB, it will result to cochlear hair cells damage. Thus, it will worsen the degeneration process of the auditory nerves and cause damage in cortical hearing receptors in the inner ear.²

METHOD

This research is an analytical observational research using cross-sectional approach toward 45 respondents. The respondents in this research are those who: 1) often use earphone; 2) willing to fill the informed content; 3) never suffer from any disease in hearing system or other disease that cause hearing disorders; 4) are not undergoing treatment to cure hearing disorders; 5) are not using hearing aids to improve the performance of their hearing system.

RESULT

Characteristics of the Subject

Based on age category (Table 1), the respondents are dominated by those who are 16 until 22 years old 36 respondents (80,0%). All of the respondents actively use earphone as seen from their intensity of earphone use 26 respondents (57,8%) use earphone for ≤ 3 hours in a week, 15 respondents (33,3%) use earphone for 4-6 hours in a week, and 4 respondents (8,9%) use earphone for ≥ 7 hours in a week. As for the duration of earphone use 15 respondents (33,3%) have used earphone for 1-12 months, 21 respondents (46,7%) have used earphone for 1-5 years, and 9 respondents have used earphone for $\geq 5-10$ years. Based on type of devices there are 44 respondents (97,8%) use MP3, cellular phone, portable radio, PDA, and there is 1 respondent (2,2%) use laptop.

Based on the frequency of right ear (Table 2) audiometric result the threshold increase mostly happen in the frequency of 500 Hz 10 respondents (22,2%). While the threshold increase leastly happen in the frequency of 4000 Hz 1 respondent (2,2%).

Whereas based on the the frequency of left ear (Table 3) audiometric result the threshold increase in left ear mostly happen in the frequency of 250 Hz 5 respondents (11,1%). While the threshold increase leastly happen in the frequency of 4000 Hz and 8000 Hz 1 respondent (2,2%).

Table 1. Characteristics of the Subject

Subject Variable	Explanation	Frequency (%)
Age	16-22 years old	36 (80.0%)
	23-28 years old	9 (20.0%)
	Maximum age	28 years old
	Minimum age	16 years old
Intensity of Use	≤ 3 hours in a week	26 respondents (57.8%)
	4-6 hours in a week	15 respondents (33.3%)
	≥ 7 hours in a week	4 respondents (8.9%)
	The maximum intensity of use	≥ 7 hours in a week
Duration of Use	The minimum intensity of use	≤ 3 hours in a week
	1-12 months	15 respondents (33.3%)
	1-5 years	21 respondents (46.7%)
	≥5-10 years	9 respondents (20.0%)
Type of Devices	The maximum duration of use	≥ 5-10 years
	The minimum duration of use	1-12 months
	MP3, cellular phone, portable radio, PDA	44 respondents (97.8%)
	Laptop	1 respondent (2.2%)
	Type of device that is used maximally	MP3, cellular phone, portable radio, PDA
	Type of device that is used minimally	Laptop

Table 2. Characteristics of the frequency in Right Ear

Parameter	Right Ear				
	Normal	Threshold Increase	Maximum Threshold	Minimum Threshold	Deviation Standard
125 Hz	40 (88.9%)	5 (11.1%)	35 db	-5 db	0.318
250 Hz	40 (88.9%)	5 (11.1%)	30 db	5 db	0.318
500 Hz	35 (77.8%)	10 (22.2%)	35 db	5 db	0.420
1000 Hz	38 (84.4%)	7 (15.6%)	25 db	10 db	0.367
2000 Hz	40 (88.9%)	5 (11.1%)	25 db	-5 db	0.318
4000 Hz	44 (97.8%)	1 (2.2%)	30 db	-5 db	0.149
8000 Hz	43 (95.6%)	2 (4.4%)	35 db	-10 db	0.208

Table 3. Characteristics of the frequency in Left Ear

Parameter	Left Ear				
	Normal	Threshold Increase	Maximum Threshold	Minimum Threshold	Deviation Standard
125 Hz	43 (95.6%)	2 (4.4%)	35 db	-5 db	0.208
250 Hz	40 (88.9%)	5 (11.1%)	35 db	-5 db	0.318
500 Hz	41 (91.1%)	4 (18.9%)	35 db	-5 db	0.288
1000 Hz	42 (93.3%)	3 (6.7%)	40 db	-5 db	0.252
2000 Hz	43 (95.6%)	2 (4.4%)	40 db	-5 db	0.208
4000 Hz	44 (97.8%)	1 (2.2%)	35 db	-10 db	0.208
8000 Hz	44 (97.8%)	1 (2.2%)	45 db	-10 db	0.149

DISCUSSION

Table 4. The Correlation between the intensity of earphone use and the frequency of audiometry result in Right Ear

Parameter	Right Ear			Correlation coefficient, P value
	≤3 hours in a week (low)	4-6 hours in a week (medium)	≥ 7 hours in a week (high)	
125 Hz	<i>N</i>	<i>N</i>	<i>N</i>	
Normal	23	13	4	-0.124,
Threshold increase	3	2	0	0.764
250 Hz				
Normal	23	13	4	-0.124
Threshold increase	3	2	0	0.764
500 Hz				
Normal	21	11	3	0.172,
Threshold increase	5	4	1	0.597
1000 Hz				
Normal	21	13	4	-0.378
Threshold increase	5	2	0	0.298
2000 Hz				
Normal	23	13	4	-0.124,
Threshold increase	3	2	0	0.764
4000 Hz				
Normal	26	14	4	0.733,
Threshold increase	0	1	0	0.311
8000 Hz				
Normal	25	14	4	0.064,
Threshold increase	1	1	0	0.917

Table 4 and 5 shows no significant correlation between the intensity of earphone use and the frequency of audiometry result. However, there is a threshold increase in the frequency of 500 and 1000 Hz in right ear with the intensity of use ≤ 3 hours in a week (low).

Based on a research conducted by Archana Rao in 2014, entitled *Effect of Usage of Personal Music Players on Hearing in Students Aged 18-25 Years*, the duration of earphone use affects our hearing ability. 10 from 98 respondents (10,2%) who use earphone for listening music less than 3 hours each day suffer from hearing disorder, while 3 from 5 respondents (60%) who use earphone for listening music more than 3 hours each day also suffer from hearing disorder. Based on the research, the risk of suffering from hearing disorder among people who use earphone for listening music more than 3 hours each day is 13 times higher, which is statistically significant ($p=0,001$).³

Table 5. The Correlation between the intensity of earphone use and the frequency of audiometry result in Left Ear

Parameter	Left ear			Correlation coefficient, P value
	≤ 3 hours in a week (low)	4-6 hours in a week (medium)	≥ 7 hours in a week (high)	
125 Hz	<i>N</i>	<i>N</i>	<i>N</i>	
Normal	25	14	4	0.064,
Threshold increase	1	1	0	0.917
250 Hz				
Normal	23	13	4	-0.124
Threshold increase	3	2	0	0.764
500 Hz				
Normal	24	14	3	0.253,
Threshold increase	2	1	1	0.620
1000 Hz				
Normal	24	14	4	-0.250,
Threshold increase	2	1	0	0.636
2000 Hz				
Normal	26	13	4	0.733,
Threshold increase	0	2	0	0.146
4000 Hz				
Normal	26	14	4	0.733,
Threshold increase	0	1	0	0.311
8000 Hz				
Normal	26	14	4	0.733,
Threshold increase	0	1	0	0.311

Based on the duration of earphone use that is correlated with the frequency of audiometry result in table 6, there is a threshold increase in the frequency of 500 Hz in right ear (duration use: 1-5 years). However, there is no statistically significant impact between the duration of earphone use with hearing disorder (Table 6 and 7).

Table 6. The Correlation between the duration of earphone use and the frequency of audiometry result in Right Ear

Parameter	Right Ear			Correlation coefition, P value
	1-12 months	1-5 years	≥ 5-10 years	
125 Hz	<i>N</i>	<i>N</i>	<i>N</i>	
Normal	15	18	7	0.682,
Threshold increase	0	3	2	0.053
250 Hz				
Normal	13	18	9	-0.350,
Threshold increase	2	3	0	0.317
500 Hz				
Normal	12	16	7	0.055,
Threshold increase	3	5	2	0.855
1000 Hz				
Normal	13	19	6	0.326,
Threshold increase	2	2	3	0.373
2000 Hz				
Normal	12	19	9	-0.619,
Threshold increase	3	2	0	0.102
4000 Hz				
Normal	15	20	9	0.250,
Threshold increase	0	1	0	0.426
8000 Hz				
Normal	14	21	8	0.094
Threshold increase	1	0	1	0.895

Table 7. The Correlation between the duration of earphone use and the frequency of audiometry result in Left Ear

Parameter	Left Ear			Correlation coefficient, P value
	1-12 months	1-5 years	≥ 5-10 years	
125 Hz	<i>N</i>	<i>N</i>	<i>N</i>	
Normal	14	20	9	-0.462,
Threshold increase	1	1	0	0.420
250 Hz				
Normal	13	18	9	-0.350,
Threshold increase	2	3	0	0.317
500 Hz				
Normal	14	19	8	0.173,
Threshold increase	1	2	1	0.692
1000 Hz				
Normal	13	20	9	-0.675,
Threshold increase	2	1	0	0.179
2000 Hz				
Normal	15	19	9	0.250,
Threshold increase	0	2	0	0.335
4000 Hz				
Normal	15	20	9	0.250,
Threshold increase	0	1	0	0.426
8000 Hz				
Normal	15	20	9	0.250,
Threshold increase	0	1	0	0.426

In a research entitled *Audiometric Treshold and Portable Digital Audio Player User Listening Habits* conducted by Katya Feder, Leonara Marro, Stephen E. Keith, and David S. Mischaud (2014), which used Cohort method, it is shown that there is a correlation between the use of MP3 player with the frequency of average pure high notes. In the category of 1-<3 years, the P value is 0.00318. While in the category of 3-≤5 years, the P value is 0.03015. In the category of >5 years, the P value is 0.0143.⁴

Damage caused by noise is based on frequency, intensity, and duration. Too much noise exposure to hair cells will cause the increasing production of reactive radical oxygen and will lead to cell death. Both outer and inner hair cells will be damaged, but the outer one is more fragile, starting from the basalt part to the cochlea.⁴

Based on type of devices (Table 8) that is correlated with the frequency of audiometry result, the biggest treshold increase happen in the frequency of 500 Hz in right ear, in which the used decives are MP3, cellular phone, portable radio, and PDA. However, there is no statistically significant impact between type of devices use with hearing disorder (Table 8 and 9).

Table 8. The Correlation between the type of devices and the frequency of audiometry result in Right Ear

Parameter	MP3, Cellular phone, portable radio, PDA	Right Ear Laptop	Correlation coefficient, P value
125 Hz	<i>N</i>	<i>N</i>	
Normal	39	1	-1.000,
Threshold increase	5	0	0.343
250 Hz			
Normal	40	0	1.000,
Threshold increase	4	1	0.301
500 Hz			
Normal	34	1	-1.000,
Threshold increase	10	0	0.320
1000 Hz			
Normal	37	1	-1.000,
Threshold increase	7	0	0.330
2000 Hz			
Normal	39	5	-1.000,
Threshold increase	1	0	0.469
4000 Hz			
Normal	43	1	-1.000,
Threshold increase	1	0	0.469
8000 Hz			
Normal	42	1	-1.000,
Threshold increase	2	0	0.400

Table 9. The Correlation between the type of devices and the frequency of audiometry result in Left Ear

Parameter	MP3, Cellular phone, portable radio, PDA	Left Ear Laptop	Correlation coefficient, P value
125 Hz	<i>N</i>	<i>N</i>	
Normal	43	0	1.000,
Threshold increase	1	1	0.301
250 Hz			
Normal	40	0	1.000,
Threshold increase	4	1	0.301
500 Hz			
Normal	41	0	1.000,
Threshold increase	3	1	0.301
1000 Hz			
Normal	42	0	1.000,
Threshold increase	2	1	1.301
2000 Hz			
Normal	42	1	-1.000,
Threshold increase	2	0	0.400
4000 Hz			
Normal	42	1	-1.000,
Threshold increase	2	0	0.469
8000 Hz			
Normal	43	1	-1.000,
Threshold increase	1	0	0.469

A similar research on portable compact disk player was conducted in 2001 (Keith et al, 2001). The average maximum volume in digital audio players has been increased, for example from 104 dBA to 5 dBA. This thing shows that the newest generation of digital audio player, which has bigger capability and richer kinds of features, has bigger risk compared to the preceding digital audio players.⁵

The result from a study entitled *Effect of Usage of Personal Music Players on Hearing in Students Aged 18-25 Years* shows that 12.6% out of 103 research subjects who use personal music player suffer from hearing disorder. The average of treshold decrease is 34.6 dB, happens in the requency of 4 KHz and 8 KHz. Even though these respondents never complain about the symptoms of tinnitus, the treshold decrease itself is a sign of hearing disorder's symptom.³

The increasing popularity of Personal Listening Devices (PLDs) has also increased researchers' interest to conduct a research about the impact of Personal Listening Devices use toward hearing disorder, *Peng et al. 2007*. The result of hypothesis testing between the type of devices and hearing disorder is in line with the research conducted by Le Prell et al. (2013) and Levey et al. (2011) entitled *Extended High Frequency Thresholds in College Students: Effects of Recreational Noise*. The result of the research is there is no significant correlation between the change of hearing threshold and PLD use when using PTA (Pure-tone audiometry) audiometry test and EHF (Extended High Frequency). However, there is a significant correlation when using

EHF (Extended High Frequency) audiometry test in a big scale retrospective analysis (Berg & Serpanos, 2011).⁶

A research entitled *Noise Exposure Estimates of Urban MP3 Player Users* by Levey S., Levey T. & Fligor B.J. 2011 shows that 58.2% of PLD (Personal Listening Device) users exceed the daily limit of noise exposure and 51.9% of PLD users exceed the weekly limit of noise exposure. From this, we can take a conclusion that the majority of PLD (Personal Listening Devices) users exceed the recommended limit of noise exposure, and have a higher risk to suffer from hearing disorder caused by noise.⁷

CONCLUSION

Statistically, there is no significant correlation between the intensity of earphone use, the duration of earphone use, and the type of devices toward hearing disorder.

SUGGESTIONS

- The researcher is suggested to use respondents based on the result of sample calculation in order to get equal distribution of respondents.
- In the next research, hopefully the researcher could develop more proper and safer standard for daily music exposure level in the future as well as education.

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